LANCASTER COUNTY
PLANNING

2040 Population Projections

Lancaster County, Pennsylvania

Projections & Methodology

February 2024

INTRODUCTION

What are Population Projections?

Projections are estimates of future populations based on statistical models that extrapolate past and present trends into the future. Projections can be created through very simple or very complex calculations. The type of calculations used is based on the available data and desired use of the forecast.

There is always a greater difficulty in and inherent inaccuracies in developing population projections for small geographic areas such as townships, boroughs, and small cities. Projections for larger geographic areas are more reliable, since the large population base will be less likely to exhibit short term variations. Likewise, any projection results that extend for periods beyond ten years become statistically less reliable as inputs to the projection are based on calculations rather than actual numbers. In summary, the smaller the area and the longer the period, the less likely it is a projection will be accurate.

With the above in mind, the Lancaster County Planning Department (LCPD), with previous guidance from an experienced demographer and consultant, selected a multi-step methodology, employing several sources of the most currently available data that is consistent with established demographic practices. LCPD used that methodology to develop county and municipal projections for the years 2030 and 2040. The projections can be further refined when LCPD staff work with municipalities to meet their planning needs (see **How to Use Projections and Develop Forecasts** section).

METHODOLOGY

General Description

Lancaster County

The population projections for Lancaster County as a whole were made using a *Cohort-Component Method*. This methodology first separates the population into five-year age groups by gender, called cohorts. It then applies the various components of population change (births, deaths, and migration) to each cohort in five-year increments over the projection period.

Of the three components of population change, migration is the most variable and, therefore, the most difficult to predict. To help manage migration's variability, two different methods of estimating migration were used. The use of these two methods produced two different population projections as a result.

These two projections were assumed to represent the high and low of a range of population possibilities. By averaging the high and low, **a middle projection for the county was created and used as the official projection**.

Municipalities

To calculate the municipal populations, four simple projection methods were used to project year 2020 municipal populations to 2030 and 2040. In each method, the previously determined county projection was kept as the control total. The results of the four methods were averaged to create a final projection.

These calculations were performed three times, one for each of the high, middle, and low county population control totals.

The results of the above-described calculations, using the county middle projection as the control total, became the county's municipal projections. They are based solely on the mathematical projection of existing trends and do not take into account any future policy decisions or desired population distributions.

Detailed Description

Lancaster County

Lancaster County's population projections begin with the collection of several data inputs.

- 2010 Census population of Lancaster County by age cohort and by gender[1]
- 2020 Census population of Lancaster County by age cohort and by gender[1]
- 2016-2020 Average birth rates for Lancaster County by mother's age cohort[2]
- 2016-2020 Average death rates for Pennsylvania by age cohort and by gender[2]
- 2020-2040 projected birth rates for U.S. by mother's age cohort (5-year increments)[1]
- 2015 population Vintage estimates of Lancaster County by age and gender[1]
- 2010-2020 annual deaths and live births counts[2]

[1] US Census Bureau
[2] EDDIE, PA Department of Health

Step 1

For each age cohort, Lancaster County's average birth rate is compared with the 2020 US rate and the ratio between the two is calculated (ratio=county rate/US rate). The comparison ratio is then applied to the projected US rates to compute projected Lancaster County rates.

Next, to create 5-year birth rates, the average of two adjacent years is taken and multiplied by 5. These 5-year birth rates are used in the projections.

Step 2

The Pennsylvania death rates are applied to the 2020 Lancaster County population to calculate the estimated deaths. The estimated deaths are then compared with the 2020 actual deaths for the county. A comparison ratio between the estimated and actual deaths is calculated by dividing the actual deaths that occurred by the estimated deaths (ratio=actual deaths/estimated deaths). This ratio is then applied to the Pennsylvania death rates to fit the Lancaster County deaths. To turn the death rates into survival rates, the death rates are subtracted from 1 (1-adjusted death rate=survival rate). The resulting survival rate is raised to the 5th power to create a 5-year survival rate.

Step 3

Two different methods for estimating migration are used because migration tends to be very variable. The first method is the *Adjacent Cohort Average Method*. First, the 2020 and 2010 Census data are placed side by side. Then, 2020 is "bumped down" two cohorts, so that the

same groups of people are being compared. For example, someone who is 22 years old in 2010 will be in the 20-24 year age cohort, but they will be in the 30-34 year age cohort in 2020.

Therefore the 2020 population must be bumped down by 2 cohorts. A comparison is made between the cohort population in 2020 and in 2010 by dividing the 2020 population by the 2010 population. The resulting number expresses the total population change over the 10-year period. Population change, however, is projected in 5-year increments. To express the estimated change over a 5-year period, the two adjacent cohorts are averaged. Next, the 5-year death rates are subtracted from the 5-year population change, leaving the change attributable to migration. By adding 1 to the change attributable to migration, a migration rate is created.

The second method used is the *Cohort Survival Method*. This method creates a number of net migrants for each age cohort, instead of the migration rate. This method involves the use of population by age and gender from the 2010 Census, 2015 Vintage Estimates, and 2020 Census. First, the previously determined cohort-specific survival rates are applied to each cohort in 2010, and the result is moved into the next highest age cohort. The number of actual births in the years from 2010-2015 is added to the 0-4 age cohort.

The results of this calculation are compared to the 2015 Vintage Estimates. The difference between the calculations and the 2015 Vintage Estimates is the estimated net migration. These same calculations are repeated using the 2015 and 2020 data.

Averaging the net migration calculated from 2010-2015 and 2015-2020 creates the final 5-year net migration.

Step 4

To project population, the 2020 population is first survived (the age and gender specific survival rates calculated earlier are applied to the cohorts). Next, depending on what migration method was used, migration rates or net migration numbers are applied to the survivors of each cohort. After applying the migration calculation, the result is moved into the next highest cohort. For example, the 25-29 year old female cohort is first multiplied by the survival rate. This results in subtracting out the people estimated to die. The surviving population number is then either multiplied by the migration rate (if using first migration method), or the net migration is added to it (if using second migration method). This

will add or subtract people according to estimated migration. The result of this migration calculation is placed in the 30-34 year old female cohort, because applying the survival rate and migration calculation, in effect, ages the population.

Next, birth rates are used to estimate births. The birth rates are applied to the average of the two adjacent female age cohorts. The average of the two adjacent cohorts is used because the population will change over the five-year span.

The number of births so calculated is divided between males and females. 49% are males, and 51% females. Next, infant survival rates are applied to the number of births. The infant survival rates used are the average survival rates for Lancaster County from 2015-2020. Finally, the number of surviving infants is added to the Under 5 age cohort. This process is repeated for each 5-year projection cycle.

Projection Range

Because two different methods are used to calculate migration, two different sets of projections are the result. The two projections are considered to be the high and low of a range of population possibilities. **The high and low are averaged to create a middle projection and this became the official county projection.** To express the variability of the projection, a projection range is created. The percentage difference between the middle projection and the high and low projection are calculated.

Municipalities

The county population projections calculated with the cohort-component method are next used as control totals for the municipal population projections.

The model used for the municipal projections involves the use of four different simple projection methods. For each method, municipalities' population is projected and then adjusted to fit the county total for the two projection years 2030 and 2040. **Then, the four methods are averaged for each projection year to create a final projection.**

This process is performed for the high, middle, and low county projections.
The four methods used are:

1) Averaged the 10-year growth rate from 1990-2000, 2000-2010, and 2010-2020 for each municipality. Each municipality's average growth rate was then used to project 2030 and 2040. For each projection year, the county population total was compared to the control total projected by the cohort-

component method. An adjustment factor was calculated using the county totals and applied to each municipality.

2) Averaged the numerical population increase from 1990-2000, 2000-2010, and 2010-2020 for each municipality. Each municipality's average increase was used to project the increase between 2020-2030 and 2030-2040. For each projection year, the county population total was compared to the control total projected by the cohort-component method. An adjustment factor was calculated using the county totals and applied to each municipality.
3) Averaged each municipality's share of the county growth from 1990-2000, 2000-2010, and 2010-2020. Each municipality's average share of the growth was applied to the overall county growth predicted by the cohort-component method to project the growth for that municipality. No adjustment was needed because the county control total was used in the calculation.
4) Kept each municipality's percent of the total county population in 2020 constant. So, the county's population projected by the cohort-component method in 2030 and 2040 was assigned to each municipality in the same proportion as it was in 2020.

Projection Range
As in the county projections, the percentage difference between the middle projections and the high and low projections are calculated.

The results of the above-described calculations became the county's municipal projections. They are based solely on the mathematical projection of existing trends and do not take into account any future policy decisions or desired population distributions.

How to Use Projections and Develop Forecasts

As described earlier, the county and municipal projections are purely based on use of a number of tested mathematical population projection methods. Forecasts, on the other hand, can be developed using the projections and involve making adjustments to the projections using local knowledge/data and using either technical/analytical or more intuitive methods.

Use of the projections by municipalities/partners may be perfectly fine for some planning projects or studies but may need refinement into forecasts for others.

The county and municipal projections developed should remain unchanged, but LCPD staff are willing to work with municipalities and planning regions in developing forecasts for their municipality or municipalities.

Projections by Municipality

	Census			Projections			
Municipality	*2000*	*2010*	*2020*	*2025*	*2030*	*2035*	*2040*
Adamstown Borough	1,201	1,772	1,916	2,012	2,107	2,176	2,244
Akron Borough	4,046	3,876	4,152	4,158	4,164	4,129	4,094
Bart Township	3,003	3,094	3,181	3,210	3,239	3,233	3,227
Brecknock Township	6,699	7,199	7,557	7,770	7,982	8,095	8,208
Caernarvon Township	4,278	4,748	4,609	4,671	4,733	4,745	4,756
Christiana Borough	1,124	1,168	1,112	1,115	1,118	1,111	1,104
Clay Township	5,173	6,308	6,857	7,063	7,268	7,378	7,487
Colerain Township	3,261	3,635	3,883	3,980	4,077	4,122	4,167
Columbia Borough	10,311	10,400	10,207	10,150	10,093	9,959	9,824
Conestoga Township	3,749	3,776	3,914	3,941	3,968	3,953	3,938
Conoy Township	3,067	3,194	3,361	3,415	3,468	3,481	3,494
Denver Borough	3,332	3,861	3,792	3,886	3,979	4,026	4,073
Drumore Township	2,243	2,560	2,561	2,607	2,653	2,669	2,685
Earl Township	6,183	7,024	7,144	7,305	7,465	7,536	7,606
East Cocalico Township	9,954	10,310	10,767	11,010	11,253	11,358	11,463
East Donegal Township	5,405	7,755	8,684	9,213	9,742	10,147	10,552
East Drumore Township	3,535	3,791	3,936	3,998	4,059	4,074	4,088
East Earl Township	5,723	6,507	6,699	6,824	6,949	6,993	7,036
East Hempfield Township	21,399	23,522	26,304	27,030	27,755	28,109	28,462
East Lampeter Township	13,556	16,424	17,776	18,402	19,027	19,398	19,768
East Petersburg Borough	4,450	4,506	4,573	4,593	4,613	4,587	4,561
Eden Township	1,856	2,094	2,239	2,280	2,320	2,333	2,345
Elizabeth Township	3,833	3,886	3,985	4,001	4,017	3,994	3,970
Elizabethtown Borough	11,887	11,545	11,639	11,721	11,802	11,758	11,714
Ephrata Borough	13,213	13,394	13,794	13,900	14,005	13,962	13,918
Ephrata Township	8,026	9,400	10,386	10,725	11,064	11,253	11,442
Fulton Township	2,826	3,074	3,214	3,263	3,311	3,322	3,332
Lancaster City	56,348	59,322	58,039	58,216	58,392	58,024	57,656
Lancaster Township	13,944	16,149	18,642	19,206	19,770	20,061	20,351
Leacock Township	4,878	5,220	5,652	5,740	5,828	5,847	5,866

	Census			Projections			
Municipality	*2000*	*2010*	*2020*	*2025*	*2030*	*2035*	*2040*
Lititz Borough	9,029	9,369	9,381	9,458	9,534	9,511	9,488
Little Britain Township	3,514	4,106	4,118	4,263	4,408	4,500	4,592
Manheim Borough	4,784	4,858	5,046	5,045	5,044	4,999	4,953
Manheim Township	33,697	38,133	43,977	45,473	46,968	47,803	48,637
Manor Township	16,498	19,612	21,849	22,662	23,475	23,965	24,454
Marietta Borough	2,689	2,588	2,623	2,601	2,579	2,539	2,498
Martic Township	4,990	5,190	5,221	5,285	5,348	5,353	5,357
Millersville Borough	7,774	8,168	7,903	7,888	7,873	7,794	7,714
Mount Joy Borough	6,765	7,410	8,325	8,508	8,690	8,761	8,831
Mount Joy Township	7,944	9,873	10,721	11,221	11,720	12,067	12,413
Mountville Borough	2,444	2,802	3,017	3,122	3,226	3,288	3,349
New Holland Borough	5,092	5,378	5,743	5,849	5,955	5,989	6,022
Paradise Township	4,698	5,131	5,672	5,789	5,905	5,948	5,990
Penn Township	7,312	8,789	10,210	10,581	10,951	11,166	11,380
Pequea Township	4,358	4,605	5,474	5,564	5,653	5,673	5,692
Providence Township	6,651	6,897	6,995	7,062	7,128	7,118	7,108
Quarryville Borough	1,994	2,576	2,843	2,982	3,120	3,217	3,313
Rapho Township	8,578	10,442	12,024	12,445	12,865	13,104	13,343
Sadsbury Township	3,025	3,395	3,536	3,616	3,695	3,730	3,764
Salisbury Township	10,012	11,062	11,494	11,770	12,045	12,172	12,298
Strasburg Borough	2,800	2,809	3,117	3,157	3,197	3,199	3,200
Strasburg Township	4,021	4,182	4,457	4,518	4,579	4,587	4,595
Terre Hill Borough	1,237	1,295	1,357	1,364	1,371	1,365	1,358
Upper Leacock Township	8,229	8,708	8,921	9,057	9,193	9,224	9,254
Warwick Township	15,475	17,783	19,022	19,777	20,532	21,025	21,517
West Cocalico Township	6,967	7,280	7,456	7,615	7,773	7,839	7,905
West Donegal Township	6,539	8,260	8,944	9,321	9,698	9,945	10,192
West Earl Township	6,766	7,868	8,560	8,784	9,008	9,115	9,222
West Hempfield Township	15,128	16,153	17,020	17,373	17,725	17,860	17,994
West Lampeter Township	13,145	15,209	17,383	18,168	18,952	19,477	20,002
Total	**470,658**	**519,445**	**552,984**	**565,708**	**578,431**	**584,149**	**589,866**